AGRICULTURAL EXPERIMENT STATION

Maryland
Agricultural Experiment Station

1979 Annual Report

University of Maryland
College Park • Eastern Shore

DIRECTOR'S LETTER

Agricultural research has made significant contributions toward the development of our current food and fiber system, a system in which an American farm worker now produces enough to feed 62 people. This accomplishment affects the quality of life not only of Americans, but of an increasing number of people throughout the world. Because of agriculture's successes, we tend to think that the major challenges of agricultural research are behind us, and we are in danger of being lulled into complacency.

In fact, however, the problems facing the Maryland Agricultural Experiment Station in the decade to come are as significant and challenging as ever. For instance, the ever-increasing cost and scarcity of fuels and the decreasing amount of prime farmland are conditions which force us to continually reevaluate research needs and priorities. One area of increased emphasis highlighted in this report is improving energy efficiency.

Maryland Agricultural Experiment Station researchers are involved in a number of energy-saving projects, including recycling food packaging materials, pasteurizing milk at high temperatures to eliminate the need for refrigeration, and using controlled atmosphere storage for fresh fruits and vegetables. Research on energy savings in the area of poultry production involves heating brooder houses with solar energy and lowering brooding temperatures. No-tillage crop production, a method studied by station scientists, can help control a farmer's fossil fuel requirements by eliminating seedbed preparation. Yields with this method are equal to or higher than conventional tillage yields. These energy savings translate directly into lower consumer costs.

Agricultural research is an investment that yields a rate of return as high as 35 to 50 percent. Although food prices are rising, Americans still pay a smaller percentage of their per-capita incomes for food than anyone else in the world. As we strive to continue this success, and meet the challenges presented by limitations on energy supplies, we need your continued support.

W L Harris

Benefits of Agricultural Research

Agriculture, the nation's largest industry, is the lifeline of this country. The unique cooperative research system involving the U.S. Department of Agriculture and the state land grant universities has contributed significantly to the growth and strength of American agriculture. We are entering a decade of diverse challenges for agriculture, created by events such as the increasing cost and scarcity of fuels, the decreasing amount of prime farmland, water shortages in some areas of the country and, overseas, severe food shortages with global implications. The future success of the agricultural research system in finding solutions to problems created by these events will depend greatly upon national and state resources available to support strong research programs.

Agricultural research has touched everyone's life in many ways. One can only imagine what life today would be like without its benefits: more land would be needed for production of our food supply; more erosion would blight our landscape, with the runoff carrying sediment and causing more water pollution; and food costs would be higher, requiring a greater percentage of per-capita income.

Since 1950, a 50 percent increase in crop production per acre has been realized, and farm labor productivity has doubled. The number of persons fed by each farm worker has increased from 15 to 62, and the amount of acreage used in the process of feeding and clothing an individual has been reduced by 50 percent. Although food prices rise and may seem high to us, Americans still pay a smaller percentage of per-capita income for food than do citizens of any other country in the world.

Wise use of energy is an area which offers serious and immediate challenges to agricultural scientists and engineers. It has been predicted that gasoline and diesel fuel prices will continue to rise for several years. The dramatic change in the cost of these energy sources places even greater importance on research in solar, wind and biomass sources of energy. The economics of these still relatively underexplored and consequently underutilized alternative energy sources become more appealing as fossil fuels rapidly become more costly and less available. Agricultural energy utilization studies which have energy-saving possibilities include recycling food packaging materials, sterilizing milk in such a way as to retain acceptable flavor while eliminating the need for refrigerated storage, and greater use of controlled atmosphere storage for fruits and vegetables. Energy savings resulting from research in poultry production involve using solar energy to heat broiler houses, and lowering brooding temperatures.

Even as these benefits are of value to all Americans, so are particular kinds of agricultural research especially important to Maryland's citizens. Research efforts of the Maryland Agricultural Experiment Station have contributed significantly to the sense of well-being and overall quality of life enjoyed by the state's residents. The station addresses itself mainly to the goals of supplying adequate food at reasonable prices, and of keeping Maryland agriculture strong and competitive. Since the geography of Maryland is so diverse, a variety of ongoing research projects is necessary to satisfy the needs of all areas of the state.

One project, which deals with controlling the Mexican bean beetle on soybeans in Maryland, measures the varying impacts on society of using different management programs of pesticides and biological control. Results indicate that the private returns per dollar were greater than the societal costs for some methods, and that biological control methods were more than competitive with alternative chemical control methods. Altogether, soybean research has contributed to a 35 percent increase in Maryland crop yield in the last decade. This increase is more than three times the national average.

There are other areas of research of particular benefit to Maryland. Isolation of a strain of infectious bronchitis virus harmful to poultry greatly helped that industry on the Eastern Shore. Research on reproductive problems of horses has been of benefit to the state's horse industry, which contributes well over $200 million annually to Maryland's economy. The donation of the Wye Angus herd has made possible research of the highest quality on beef cattle production. The tobacco industry so important to southern Maryland farmers is aided through research in tobacco breeding, production, harvesting and curing. Fruit and vegetable production have been improved through advances such as the development of a mechanically harvestable tomato, and improved cultural practices resulting in increased apple production. Research directed toward rural development and environmental concerns continues to add to the body of knowledge necessary to meet society's needs.

As we can see, agricultural research benefits us all in a surprisingly varied number of ways. Continued research efforts aimed at alleviating energy problems, solving waste problems while protecting our natural resources, and producing more food for domestic and global needs are essential to the development and survival of a well-nourished and adequately clothed and housed civilization.

Milk Without Refrigeration: A Potential Energy Savings

Dennis C. Westhoff

Milk is one of our most nutritionally complete foods. Unfortunately, it is also one of our most highly perishable foods. Techniques of pasteurization and refrigeration have attempted to increase its useful period or shelf life; however, milk spoils because pasteurization does not destroy all milk-spoiling bacteria. Refrigeration will retard the rate at which these bacteria can grow and spoil the product, but spoilage is inevitable.

Eliminating the requirement for refrigeration in the normal distribution and marketing of milk will represent a significant energy savings in agriculture. Despite inherent chemical and microbiological problems, Maryland Agricultural Experiment Station scientists are convinced that the distribution of milk without refrigeration is possible and highly probable in the United States.

Station scientists have just completed several phases of a study that may enable milk to be sterilized, aseptically packaged and distributed to the consumer without refrigeration. In the system being tested, milk is rapidly heated to a minimum of 280°F for 2 seconds or longer, and quickly cooled. This intense heat kills all bacteria, eliminating the major spoilage problem in milk. When this sterilized milk is aseptically packaged into presterilized cartons, it requires no refrigeration.

Sterilized, aseptically packaged milk is not a new concept. Milk exposed to ultrahigh temperature processing techniques (UHT milk) is available in many European countries and in parts of Canada. However, the major obstacle to the introduction of a sterilized or UHT milk in the United States has been the objectionable cooked flavor of milk heated to such high temperatures. The uniqueness of the system being tested at the University of Maryland is that the sterilized milk cannot be distinguished on the basis of flavor from regular pasteurized milk.

Sterilized milk, which eliminates the need for refrigeration, represents a significant energy savings.

Consumer Acceptability

Both informal and formal experiments have been conducted by Station scientists on the taste of sterilized milk produced on the College Park campus. Over 1,500 students were given a sample of sterilized milk and two samples of pasteurized milk, or two samples of sterilized milk and one sample of pasteurized milk. They were then asked to identify the odd sample in the three samples. In this side-by-side comparison, the sterilized milk could not be distinguished from the pasteurized milk a significant number of times.

In other experiments, trained taste panelists were asked to evaluate sterilized milk *stored unrefrigerated* and compare it to freshly pasteurized milk. These panelists could not distinguish between sterilized milk which had been stored nonrefrigerated for up to 9 weeks and freshly pasteurized nonstored milk.

A sterilized, acceptable milk represents a tremendous potential savings in energy by eliminating refrigerated distribution and storage. For this reason, Station scientists are optimistic about the future of such products in the United States.

Nutritional Quality

Several ongoing Agricultural Experiment Station projects complement this continuing study. For example, Station scientists are interested in determining the effect of sterilization heat on various enzymes, nutrients and vitamins. It appears that the rapid heating of sterilization may be less harmful to many nutrients and vitamins than the relatively low, prolonged heating of pasteurization. However, the nutritional soundness of sterilized, aseptically packaged, nonrefrigerated milk will have to be demonstrated. Some of the microbially synthesized enzymes normally present in milk are known to be extremely heat resistant, and survival of these enzymes may affect the flavor and shelf life of sterilized milk if it is held for several months.

Other Dairy Products

The availability of sterilized milk has led to other interesting areas of investigation: Station scientists are exploring the possibility of using a sterilized milk as the substrate for cultured dairy products such as cottage cheese and yogurt. Cultured dairy products require that milk be inoculated with high levels of starter culture bacteria. The question arises as to whether or not the sterilized milk will serve as a suitable substrate for the starter culture bacteria normally used in cultured dairy products. Experiments have confirmed that sterilized milk is just as suitable a substrate as pasteurized milk for many dairy starter culture organisms. Other ongoing studies are concerned with the resulting body, texture and yield of products produced from sterilized milk.

Samples of sterilized milk are collected for consumer acceptability tests. In comparisons with pasteurized milk, the taste of sterilized milk was not found to be significantly different.

These experiments are of interest to the dairy processor because, in a given milk processing plant, sterilized milk might be used as fluid milk or as an ingredient in other dairy products, such as ice cream mix. Station scientists are evaluating the time-temperature parameters required for the heat treatment of ice cream mix, and are determining the quality of the ice cream produced from these processed mixes.

Energy Savings

The benefits of such research have direct local and national implications. A tremendous energy savings would result if dairy processors converted from conventional pasteurized fluid milk systems to the newer sterilized acceptable milk techniques. The introduction of this type of system on a national basis could save an estimated 12 million barrels of petroleum per year. These energy savings convert to dollar savings for both the dairy processor and the consumer through reduced refrigeration costs.

Station scientists are excited about the Maryland Agricultural Experiment Station's prominent position in the sterilized milk research area. Additional phases of this study have been outlined to include further energy evaluation studies, the installation of a pilot plant facility, evaluation of various packaging materials, widespread demonstration of the product and continuing nutritional microbiological and engineering studies.

The introduction of a sterilized, aseptically packaged, nonrefrigerated milk may be several years away. For that reason, Station scientists are continuing research efforts on improving the shelf life of pasteurized milk. Ongoing research projects involve monitoring the microbiological and consumer acceptability of pasteurized milk when held at several refrigeration temperatures.

A shelf-life study of all the commercially available brands of pasteurized milk produced in Maryland has just been completed. The data generated by this study will be used to predict the refrigerated shelf life of each individual brand of milk. Such studies help to maintain the excellent keeping quality of pasteurized milk produced in Maryland. Additionally, the data from this study served as the base of information used to modify the sell-by dating regulations for pasteurized milk in Maryland.

Current shelf-life studies of milk involve monitoring the microbiological acceptability at several refrigeration temperatures.

More Efficient Pest Control Decreases Costs

Floyd P. Harrison

Unlike most agricultural sciences, entomology, the study of insects and their close relatives, is not concerned with the production of any commodity or group of related commodities. It is, however, the study of a group of animals that compose about 75 percent of all animal species. They are the the most versatile organisms alive, affecting in some manner virtually everything that man has, grows or manufactures, even man himself. Entomology lends support to almost every human endeavor that deals with maintaining our health, sanitary conditions, economic stability and supply of wholesome food.

Insect pests, such as scale on ornamental plants, require accurate timing for chemical control.

Insect Pests of Ornamental Plants

As our society becomes more urban, the importance of insect control on all ornamental plants increases. However, developing techniques for the safe and effective control of such pests as scale insects, mealy bugs, mites and aphids is complex. Some of these pests, such as scales and mealy bugs, have very complex life styles; chemical control must be precisely applied at exactly the correct time for the chemicals to work.

There are a number of chemicals that can be used on ornamentals, each having its own advantages and disadvantages. Experiment Station researchers are evaluating these chemicals to determine their most efficient use, which ultimately means a savings of chemicals, energy and expense.

Nonchemical methods of insect control are also being developed and evaluated. One such development is the use of synthetic hormones against scales and mealy bugs on greenhouse plants. These hormones are specific, nontoxic and nonpolluting.

Biological Control

Insects are subject to a wide variety of diseases caused by every kind of microorganism. Viruses, the more infectious and virulent microbes, have great potential for use in population control. They are specific, and in many cases cheaply and easily produced. They are also nonpolluting and very effective with some insects. There are many things to consider in the development of viruses, such as techniques for production and use, dosage and range of effectiveness. There is even the question of altering the genetic make-up of a virus to make it more effective as a control agent.

Pests infesting stored products such as grains pose an especially difficult problem because they contaminate a consumable product. The use of microbes such as microsporidians may reduce these pests.

Insect Pests of Vegetables

The vegetable industry, a large portion of Maryland agriculture, is concentrated on the Eastern Shore, where Experiment Station research is conducted. Among the more important research objectives is the development of safer, more efficient chemicals for control of the insects attacking vegetable crops. For example, the use of systemic compounds to control Colorado potato beetle and other insects, especially on tomatoes, is in the developmental stage. As chemical insecticides become more sophisticated, their use becomes more specialized and more precise. These improved chemicals are more efficient; the resulting increase in production and decrease in production costs represent an energy savings.

Along with the development and introduction of improved chemicals come the techniques which make their use more precise. As a part of this work, researchers are developing techniques to improve application methods, sampling procedures for pest detection and thresholds by which intelligent decisions are made as to whether chemical application is really needed. All of this ultimately results in an economy of fuel, chemicals (which are petroleum products) and labor. The crops most directly involved are tomatoes, cole crops, sweet potatoes, beans and spinach.

Nonchemical means of control are not ignored: bacteria and viruses are also under investigation as pest management tools, as well as cultural methods used to reduce crop losses due to insects.

Insect Pests of Field Crops

Field crops are grown for forage, grains and fibers, and include most all crops not considered fruits or vegetables. The principal field crops in Maryland are grain corn, soybeans and small grains, and are damaged by a wide variety of pests. Corn, for instance, is damaged severely at times by armyworms, cutworms, European corn bórer, stalk borers and fall armyworms. Soybeans are damaged by Mexican bean beetle and spider mites, grains by armyworms and cereal leaf beetle.

Basic to good management of these pests are questions of proper survey and sampling techniques used to determine the presence of certain pests and their relative numbers. This type of information helps determine how much insect control is indicated. An additional problem involves determining the proper action thresholds for those pests. Little is known at present about the population dynamics of insects in field crops, especially the role of beneficial insects in influencing pest populations. Another question under consideration is how insecticides affect beneficial insects. One Experiment Station project is devoted entirely to answering these and similar questions, so that efficient and effective pest management can be put into effect.

Orchard, Small Fruit and Vineyard Pests

Fruits, especially orchard fruits, are a major part of Western Maryland's agricultural production. These fruits are attacked by a variety of pests, and the insect damage is often very severe. Public demand for unblemished fruit is so high that good pest management is one of the essential determining factors of fruit production.

In addition to insects, these fruits become infected with a variety of diseases which must be controlled by chemicals. However, these chemicals are only as effective as the efficiency with which they are applied, so adjustment of spray schedules, development of methods of monitoring the presence of pests and refinement of application techniques are always under investigation.

In the last few years, there has been an increased interest in grape production by homeowners, and in commercial wine production. As a result of this interest, Station researchers have increased their efforts to improve the methods of pest management for grape pests such as phylloxera, Japanese beetle and grape flea beetle.

Forest Insect Research

The Nantucket pine tip moth, which attacks both forest and ornamental pine trees, invades the tip of the pine branch, causing eventual distortion. It also significantly retards the growth of pine trees. Spraying to control pine tip moth is difficult: timing of the treatments is critical and the expense is prohibitive. In all probability, biological control by some effective parasite will be the most practical approach to controlling this insect. However, before work on developing biological control pro-

cedures begins, ways must be devised to colonize and rear the insect in the laboratory. The immediate problems are developing a synthetic diet for the insect and discovering ways to control its hibernation, or diapause cycle.

These research projects in insect control are only a few being conducted by the Maryland Agricultural Experiment Station. It is through these projects, supporting various areas of production, that the entire spectrum of Maryland agriculture is served. This in turn strengthens our economy, conserves the energy used for production of crops and insures a continuing supply of wholesome food.

The Nantucket pine tip moth retards the growth of pine trees and causes eventual distortion. Biological control, the most practical alternative, depends on colonizing and rearing the insect in the laboratory.

Alternative Energy Sources in Poultry Production

James L. Heath

Energy costs are limiting the ability of the poultry industry to provide a high quality product at a reasonable cost to the consumer. The increased costs of poultry products have a substantial effect on the consumer, because 7 percent of his or her total diet is provided by poultry meat and eggs. Beef, pork, veal, lamb and fish together provide only 13 percent of an average diet.

Costs of fossil fuels have increased the costs of poultry production, which are reflected in increased prices at the market. Maryland Agricultural Experiment Station scientists are studying ways in which energy costs can be reduced by using less expensive energy sources, and by using energy more efficiently.

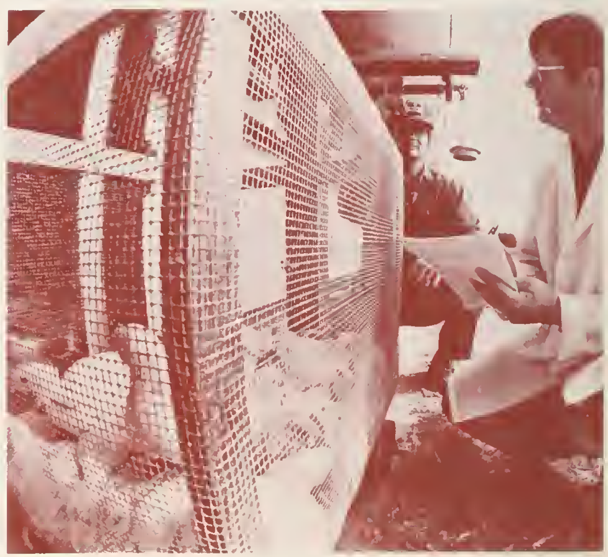
Broilers

In 1978, Maryland broiler producers spent $43.5 million on heat, light and power to produce 397 million broilers. Energy added 11 cents to the cost of each broiler produced. However, solar energy can be used to replace a substantial portion of the energy required to brood and grow broilers.

Station scientists designed and installed a solar collector on a test facility at the Environmental Research Broiler Facility in Salisbury, Maryland. The system, which originally used hot water to store and transport the collected energy, has been modified to include a heated rock storage, and to transport the heated air directly to the test chambers. Efficiency was increased to the point that 78.8 percent of the LP gas normally used by this facility was saved by combining limited area brooding with solar energy heating. Limited area brooding reduces the amount of heat required to maintain the brooding area at the correct temperature. As the cost of LP gas continues to increase, solar energy will become even more attractive.

The broilers were not adversely affected by these experiments, producing a high quality product. Industrial application of a similar system on a commercial scale could provide 50 to 70 percent of the energy requirements for broiler production.

The high fixed costs of the solar energy system can be recaptured by maximum utilization and increased efficiency. The economic use of solar energy in broiler production will depend upon finding other uses for the excess energy produced and reducing the fixed costs. As each experiment is completed, the solar facility is altered and poultry management techniques are changed to make the facility more efficient and commercially applicable. Each phase of collection, transport, storage and use is being evaluated by Experiment Station researchers.



Weight gains and performance of broilers are not significantly reduced by lowering temperatures and light intensity.

Conventional Energy Savings

Even conventionally obtained energy can be conserved and used more efficiently in poultry production without sacrificing product quality. The largest amount of energy is used in the first 3 to 5 weeks of the 8-week growing cycle. Up to 40 percent of the fuel can be saved by lowering brooder temperatures without affecting weight gain and feed conversion, and with only a slight increase in mortality. Economic conditions will determine how much mortality can be allowed before fuel savings are negligible.

Reducing the light intensity and using intermittent lighting will conserve electricity during the growing period without adversely affecting the performance of the broilers. Since broilers are normally given 24-hour light, this savings could be substantial, particularly in windowless houses where all the light must be provided by electricity.

Broiler houses are ventilated using large fans, and at present the ventilation rate cannot be lowered substantially because it affects the weight of the broiler. However, research is continuing in an effort to determine methods of reducing the amount of energy required for ventilation.

Layers

Shell egg packers are concerned about the escalating costs of storing and packing shell eggs, especially the cost of energy as a percentage of the total cost. A large portion of this energy cost can be attributed to current methods of cleaning and storing shell eggs.

Station research shows that eggs can be cleaned effectively and efficiently with dilute acetic acid. This method requires no heating of the cleaning media and no detergents to clean the eggs; energy savings are substantial. Also, the cleaning solution is acid rather than alkaline which makes land application after it has been used to clean the eggs attractive in some areas. With current egg washer designs modified to handle an acidic solution, 410 million Btu for each 140 case/hour machine could be saved each year. Detergents are not required, representing an additional saving.

This method of cleaning eggs is also adaptable to the small backyard operation, where eggs are immersed in a bucket. The microorganisms on the egg are reduced and remain at a low level even under storage conditions not considered optimum. The acid, produced by biological fermentation, can be easily obtained from local suppliers. Even vinegar is sufficiently acid to be effective in cleaning shell eggs.

Acetic acid can be used to clean eggs with no effect on internal quality and with substantial energy savings.

Ultrasonics can be used to increase the efficiency of the cleaning system if proper controls are used to prevent penetration of the cleaning solution through the shell to the interior of the egg. The length of exposure to the ultrasonics and the cleaning solution, the cleaning solution and the egg temperature can be adjusted to prevent this penetration. The cost of including ultrasonic units in current commercial units is comparable to the cost of present pumps and spray mechanisms.

The dilute acetic acid cleaning method, with or without ultrasonics, does not weaken the shell more than commercial washing. No effect was found on interior quality, functional properties or organoleptic quality with either method of cleaning with dilute acetic acid. Microbial quality was significantly improved.

Station research has indicated that egg storage temperatures can be increased by 10°F without damaging product quality; however, the eggs must be treated with proper handling and storage procedures to insure a safe, high quality product. A cooler big enough to store 10,000 cases of eggs can save over 48,000 Btu each hour if the storage temperature is increased by 10°F.

High Quality, Lower Cost Food Storage

Amihud Kramer

In our highly urbanized society, it is essential to preserve a large part of the food we raise so that it will be available for consumption year-round. With the assistance of the Maryland Agricultural Experiment Station, the food processing industry in Maryland has grown and prospered to such an extent that Maryland's contribution to processed foods is substantially larger than Pennsylvania or even Texas, and approximately equal to New York, Florida or Illinois. To achieve this position in food processing, much of the research before the energy crunch of 1974 consisted of improving yields of raw material and prepared consumables, and at the same time reducing problems of waste disposal.

Although these efforts to increase yields and minimize waste were helpful in reducing energy consumption, the focus of Station research changed after 1974 to savings in energy with negligible reductions in quality or increase in waste. Scientists first studied all of the major forms of food preservation to determine which were the more energy-intensive, and where the opportunities were for energy saving. Considering the total marketing system from point of harvest or slaughter to food served to the consumer yielded a number of surprising findings.

Raw food, cleaned, packaged, refrigerated and distributed to the consumer for home preparation, is as energy intensive as more highly processed foods. Somewhat more energy is utilized per serving of canned foods, and somewhat less for the equivalent frozen foods. The major energy-saving opportunity for raw, home-prepared food involves more efficient small-scale home preparation techniques, and reduction of waste during preparation and consumption. The opportunities for energy saving in canning are primarily in developing a less energy-demanding container, and in reducing the thermal energy required to sterilize the product. Obviously, for frozen products, the best opportunity for energy saving lies in reducing the energy used for freezing and maintaining the product in frozen storage.

Energy Saving in Frozen Storage

The shelf life of refrigerated foods depends on the temperature and time of storage, and the same food products can be stored at higher temperatures for shorter time periods. However, this is not practical, since it would be difficult to separate large commercial warehouses or home refrigerator-freezers into compartments with different storage temperatures to save some energy. For these practical reasons, frozen storage is usually maintained at close to −10°F. Commercial coolers as well as household refrigerators usually maintain temperatures at 38-40°F, although it would definitely be appropriate to have a section close to 30°F, another at about 40°F and perhaps a third at 50°F.

Station scientists have developed break-even information for frozen storage of various foods based on the temperature and length of storage.

An extensive study was undertaken to determine how much energy can be saved if freezer temperatures are maintained at −5°F or at 0°F and allowed to fluctuate plus or minus 5°F or even 10°F. The results indicate that, in general, product quality or shelf life would suffer very little if freezer temperatures were maintained at −5°F and allowed to rise up to 0°F occasionally. At the same time, approximately 20 percent of the energy utilized for refrigeration could be saved.

Cost/Benefit Relationships for Low Temperature Storage

The quality and acceptable shelf life of all perishables is reduced by storage at common and higher temperatures; therefore, cooling raw or processed foods is the simplest and most direct method of extending their shelf life and retaining their sensory and nutritive value. Cooling, however, is an expense, and a major energy cost for foods which are frozen and stored at temperatures below 0°F. However, even canned, dehydrated and raw foods benefit substantially from reduced temperatures above as well as below their freezing point.

Station scientists, therefore, have developed a computer program which balances energy costs and gains in sensory and nutritional quality retention for a variety of foods, both raw and processed. Detailed break-even information for over 50 commodities is now available, and while some foods are now being handled optimally, there are many opportunities for saving energy by changing the storage temperatures now generally used.

For example, there is no reason for holding orange juice and other acid fruit concentrates below 0°F, if they are to be consumed within 1 or even 2 years. Therefore, a storage temperature of +10°F is adequate for citrus concentrates. Frozen strawberries, however, should be stored below 0°F. Frozen poultry should also be stored below 0°F unless it is to be consumed within 2 to 3 months of slaughter; then it can be stored safely at +10°F.

The most basic finding of these cost/benefit studies is that food does not decay most rapidly immediately following harvest or slaughter, as previously assumed, then deteriorate more slowly. Particularly for processed foods, the decay rate follows a three-phase order, with little if any initial quality loss. After a period of hours or days for raw foods and 3 to 9 months for processed foods, the rate of quality loss is rapid, then slows down again. This fundamental discovery of the nature of "aging" may now be used to develop prediction equations to determine the quality retention of all types of foods processed and stored under any given conditions.

Food samples are tested for certain spoilage-producing enzymes inactivated by the GASPAK process.

Energy Saving in Canning

Although the cannning process is supposed to convert perishable food to "stabilized" food, Station research indicates that certain canned foods deteriorate fairly rapidly, particularly if they are left on the shelf during hot summers. In such situations, an actual net saving in total and energy costs can be demonstrated if canned foods are stored in a cool place (below 70°F), even if some degree of refrigeration is required.

The best opportunity for energy saving for canned foods is in reducing the energy used to produce the container. The retortable pouch, recently approved by the Food and Drug Administration for use in the United States, may eventually be the answer. Current Station studies, however, show that the retortable pouch is presently more, not less, expensive than the conventional cylindrical can, although quality advantages are real. Eventually an all-plastic, rigid, shallow container which can be sterilized with microwave energy may provide canned foods that are not only better than the existing canned foods in quality, but also less energy and total cost intensive.

Energy Reduction for Fresh Foods

Some food scientists, dietitians and the vast majority of consumers are firmly convinced that the fresh raw product is the best, and that any form of processing, storing and handling of the fresh raw product reduces its quality and nutritive value. However, by the time the consumer buys and eats the raw food, it has deteriorated far more than a fresh-frozen or even a fresh-canned equivalent. Also, the energy input for preparing these foods for consumption is greater than the energy input for many processed foods. It appears, therefore, that we must find a method that retains "like-fresh" quality in prepared foods without drastically altering their natures or expending substantial energy.

After 2 years of intensive work, Experiment Station scientists have made significant progress in developing just such a procedure: the GASPAK process. The GASPAK process is based on the physiological principle that any biological tissue, as soon as it is separated from the living biological unit, undergoes a spoilage process. This spoilage is caused by certain enzymes which are endemic within the tissue, or are produced by microorganisms infecting the tissues. All that is needed to prevent raw foods from spoiling is to promptly inactivate the specific spoilage enzymes.

The canning and freezing processes accomplish their preservative effects by inactivating the enzymes through heat exchange. But at the same time they change the nature of the raw material and expend substantial amounts of energy. Dehydration is effective in controlling spoilage because it reduces water activity to a level at which the enzymes are inactive, but dehydration usually alters the quality of the raw material even more than freezing and canning, and is more energy intensive.

The GASPAK process inactivates enzymes by means of gas exchange. The first step in the process is to evacuate the atmosphere surrounding the food particles and the atmosphere within the tissues. This inactivates the aerobic enzymes, and in some cases increases the shelf life of raw foods several fold. However, anaerobic enzymes and microorganisms are still freely active. The second step, therefore, is to break the vacuum with a gas that inactivates aerobic and anaerobic enzymes. To prevent possible formation of undesirable residues, a third step is usually needed which involves flushing out the residual enzyme-killing gases and replacing them with additional inert gases which remain in the final package.

Energy costs for performing the GASPAK process are about one-fourth the energy costs for canning or freezing. After more than 6 months' storage in film packages at summer room temperatures, raw potato strips and raw apple slices look, smell and feel just like they were freshly peeled and sliced. Other GASPAK-processed products that have been stored for shorter periods are sliced peaches, mushrooms, green beans, whole and chopped lettuce and ground beef patties. Energy saving for the process itself is about 65 percent, and for the total operation from harvest to table, approximately 44 percent.

The GASPAK process preserves the "like-fresh" quality of these potatoes without drastically altering their nature or expending substantial energy.

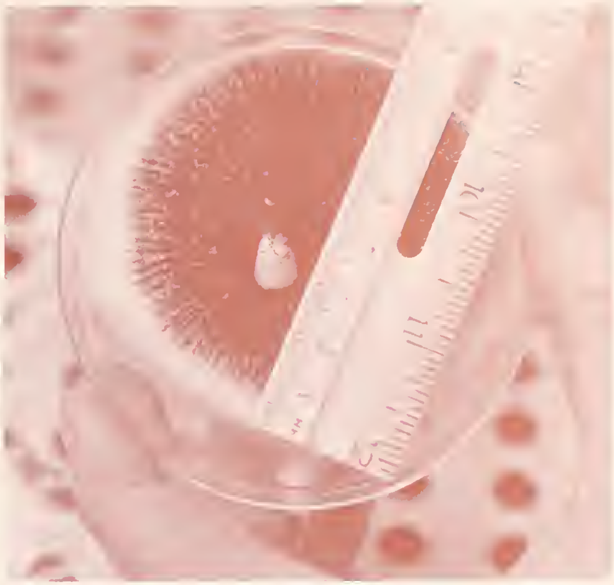
No-Tillage Production Saves Time, Labor and Energy

V. Allan Bandel

Crop production is an extremely important segment of Maryland's economy. In 1978, Maryland farmers harvested 57.2 million bushels of corn, 11 million bushels of soybeans, 32.2 million pounds of tobacco and 9.3 million bushels of wheat, barley, oats and rye for a combined value of $259 million dollars. This does not even consider the relatively large farmland acreage devoted to forages, which provide feeds for the livestock, dairy and poultry industries.

Grain production for 1979 is expected to set new records, especially for corn and soybeans. But record crop production could not have been possible without significant research advances in many related disciplines. For instance, without development and evaluation of new high-yielding crop varieties that are resistant to problem insects and diseases, and varieties that respond favorably to high levels of fertilization, crop production in Maryland would lag far behind the rest of the nation. The Maryland Agricultural Experiment Station is responsible for providing unbiased research findings that directly benefit the often unique needs of Maryland's agricultural industry.

One area of interest that has become extremely important during the decade of the 1970's has been energy and how it relates to the cost and efficiency of crop production. The agricultural industry of this country has long had a reputation for being one of the most efficient in the world. According to U.S. Department of Agriculture statistics, approximately 17 percent of after-tax U.S. family income is spent on food, compared to 50 percent or more for many countries. In 1978, every American farmer fed an estimated 62 people, compared to only 10.7 in 1940. Obviously, efficiency of agricultural production has improved. But more is being accomplished through the research of the Maryland Agricultural Experiment Station to reduce energy requirements for crop production.



Precise measurements record the effect of pest control strategies for Maryland crops.

Fossil energy requirements that a farmer can control are most directly related to crop yield and production efficiency. Energy inputs are directly related to increased crop yields. Farm output doubled from 1920 to 1970; however, energy requirements during this same period increased twentyfold. Much of this energy requirement is the result of fertilizers, but it must be understood that any significant reduction of fertilizer inputs would also significantly reduce yields. Certain inefficiencies of energy utilization do exist and are being improved upon.

There are wide variations in fossil energy inputs according to the type of tillage system used. For example, conventional corn production requires as much as 7 times the energy and 5½ times the fuel as no-tillage. No-tillage production can save up to 149,000 kcal per acre over conventional production in seedbed preparation alone.

Tillage does not represent the only high energy requirement for crop production. Storage facilities, machinery manufacture, fertilizer, seed production, pesticides, irrigation and crop drying also require high levels of energy. The energy input represented by machinery needed for corn production exceeds 400,000 kcal/acre/year. Fertilizer, particularly nitrogen, represents one of the largest energy inputs at nearly 8,500 kcal/pound, phosphorus at more than 1,500 kcal/lb. and potassium exceeding 1,000 kcal/pound. The need for efficient application rates for fertilizer as well as the use of appropriately sized machinery is obvious.

Crop drying is also energy intensive. In some areas, as much as three-fourths of the grain produced is dried with heated air, a practice that allows the farmer to harvest his crop over a wider range of time. But the amount of energy required to dry grain to a storable moisture content is being reduced by the development of improved varieties that can safely remain in the field for longer periods of time, as well as the development of improved crop drying techniques.

No-Tillage, A Revolutionary Practice

Perhaps the most revolutionary crop production practice to be adopted by Maryland farmers in recent years is no-tillage. This system not only provides savings in time, labor and energy, but it also nearly eliminates soil erosion. In addition, no-tillage allows crop yields equivalent to or higher than those expected from conventional tillage.

No-tillage of forages such as alfalfa, clover and vetch allows many crops to be seeded directly into old crop residue without plowing and preparing a finely pulverized seedbed. Energy is conserved in the forage establishment process, and also in harvesting, storage and manure spreading if animals graze the forage in place. Excellent stands are possible without the expense of excess energy expenditure.

Determining Appropriate Nitrogen Rates

Since 1973, Experiment Station researchers have been involved in an effort to determine the most efficient rates of nitrogen application on no-tillage corn. Contrary to previous belief, no-tillage corn does not require more nitrogen than conventional tillage, and it typically out-yields conventional tillage corn when fertilized at recommended nitrogen rates. This discovery means that no-tillage crops use expensive nitrogen fertilizers more efficiently than corn grown conventionally. At recommended nitrogen rates, no-tillage corn produces more bushels of grain per pound of nitrogen fertilizer applied.

No-tillage corn crops use nitrogen more efficiently than conventional tillage crops. This represents a significant energy savings.

Experiment Station research on molds affecting field crops has improved the efficiency of crop production.

Finding the Best Weed Control

Satisfactory weed control in any kind of crop production is critical. Weeds compete for many essential growth factors such as moisture, sunlight and nutrients. Good chemical weed control is especially important in no-tillage fields, since cultivation to destroy weeds cannot be carried out without disturbing the desirable organic mulch accumulated on the soil surface.

Much research has been conducted by the Maryland Agicultural Experiment Station on various weed control chemical combinations, timing of applications, rates and levels of residual chemical activity at the end of the growing season. With no-tillage, there are certain problems to overcome that are not generally as important with conventional tillage. For example, increased organic matter accumulating at the soil surface can reduce the activity of some herbicides, and application rates must be adjusted. Excessive rates are not the simple answer: chemicals are too costly to waste. Also, if active chemicals remain in the soil at season's end, the growth of subsequent crops may be slowed or stopped entirely.

Station research has resulted in great advances in the unique weed control problems associated with no-tillage crop production. A more complete understanding of the factors affecting the activity of weed control chemicals has been essential to the unqualified success of no-tillage crop production in Maryland.

Legumes as a Source of Nitrogen

Manufacturing nitrogen fertilizers is energy intensive and dependent upon the petro-fuel industry for natural gas. Natural gas serves as a source of hydrogen in the production of ammonia, the nitrogen of which comes from the atmosphere around us. This is a costly process. Experiment Station research is under way to study any potential benefits from leguminous winter cover crops as a source of nitrogen for nonleguminous crops, such as corn, that follow. Legumes have the unique ability, through the nitrogen-fixing bacteria growing in nodules on their roots, to fix enough of this atmospheric nitrogen to satisfy most of their needs. Some of this nitrogen is left in the field when the legume is killed or removed. A number of different legumes are being grown overwinter, killed and followed by no-tillage corn the next year. Nitrogen fixed by the legumes should provide some of the corn's nitrogen requirement, and substantially reduce production costs and energy requirements in the form of commercial nitrogen fertilizers.

Projects and Publications 1978-79

The Maryland Agricultural Experiment Station was established to develop, conduct and disseminate research information. The research projects, based on recommendations from farm organizations, the Cooperative Extension Service, or the scientists' knowledge of research needs, are funded by state funds, through the Maryland state legislature, and federal funds, through the Cooperative State Research Service. In addition, Experiment Station scientists collaborate with scientists and engineers of the U.S. Department of Agriculture.

This knowledge is communicated to the agricultural community through Experiment Station miscellaneous publications and bulletins. Miscellaneous publications reflect research findings with a relatively short reference value; bulletins deal with basic data which will be added to with time, and have a longer reference value.

Experiment Station scientists frequently submit scientific articles to various professional journals. These articles reflect the Maryland Agricultural Experiment Station's reputation for research excellence.

The following section lists projects, publications and scientific articles for 1978-79.

Miscellaneous publications and bulletins will be mailed free to all residents of the state who request them. Please address all requests to:

Agricultural Duplicating Services
4910 Calvert Road
College Park, MD 20742

Agricultural and Extension Education

Projects

Community Structure and Quality of Life: Measurement and Analysis. J. W. Longest, D. L. Tweed. T-23

Impact of In and Out Migration and Population Redistribution in the Northeast. J. W. Longest, D. L. Tweed. T-25

Behavioral Assessment of Crowding and Environmental Deterioration in Outdoor Recreation Settings. J. W. Longest, F. R. Kuss. T-26

Scientific Articles

Effects of Local Social Systems and Culture on Services Delivery. E. H. Owen, J. W. Longest, D. L. Tweed. Presented at the annual meeting of the Rural Sociological Society. A2640

Expectations, Preferences and Feeling Crowded in Recreation Activities. T. A. Heberlein, G. Alfano, B. Shelby, J. J. Vaske. Presented at the annual meeting of the Rural Sociological Society. A2653

The Influence of Initial Perceptions on Current Evaluations of a Recreational Resource. J. J. Vaske, M. P. Donnelly. Presented at the annual meeting of the Rural Sociological Society. A2654

Agricultural and Resource Economics

Projects

Dairy Adjustments and Supply Response in Maryland and the Northeast. J. W. Wysong. A-18-AU

Maryland Farm and Open Country Real Estate Transfers. S. Ishee. A-18-BB

Analysis of Costs and Returns to the Breeder-Owned Sectors of the Maryland Horse Industry. R. G. Lawrence. A-18-BG

Optimum Economic Management Plans for Loblolly Pine Plantations in the Mid-Atlantic United States. I. W. Hardie. A-18-DA

Contrasting Energy Transformation Technologies in Grain Production. P. W. Foster. A-18-DB

Comparative Impact of Current and Alternative Systems of Taxation on Farms and Counties. S. Ishee. A-19-AC

Economic Development Zone: A Strategy for Balanced Rural Growth and Development. W. J. Bellows. A-19-AE

Public Outdoor Recreation as a Component for Rural Development in the Appalachian Region of Maryland. I. W. Hardie, I. E. Strand, V. J. Norton. A-19-AI

An Economic Analysis of Agricultural Employment, Unemployment and Productive Changes in Maryland, the Northeast and United States. J. W. Wysong. A-19-AJ

Optimum Farm Organization for Limited Resource Farmers. D. F. Tuthill, R. Douglass. A-19-AK

Land Use, Taxes and Service Impacts of Columbia, Maryland on Howard County. W. J. Bellows. A-19-AL

Economic Analysis of the Maryland Horse Industry. R. G. Lawrence. A-26-CE

Supply, Pricing and Marketing Alternatives for Cattle, Beef Systems in the South. J. E. Via. A-26-CN

Implications of Demand, Structure and Energy Changes for the Northeast Broiler and Egg Industries. F. E. Bender. A-26-CO

An Analysis of the Spatial Organization of the Northeast Dairy Industry. A. M. Prindle. A-26-CQ

Socioeconomic Factors and Rural Land Use. S. Ishee, B. V. Lessley. A-26-CR

Comparative Costs and Relative Efficiency of the Delmarva Poultry Industry. J. E. Via. A-26-CS

Dairy Production and Waste Disposal Systems in the Monocacy River Watershed. B. V. Lessley. A-26-CT

Scientific Articles

Application of a Simulative Approach to Evaluating Alternative Methods for the Control of Agricultural Pests. K. H. Reichelderfer, F. E. Bender. A2566

Efficiencies in Large-Scale Dairying: A Comment. J. W. Wysong. Americal Journal of Agricultural Economics. A2578

Effect of Farm Size and Level of Vertical Integration on Returns to Management in the Commercial Turfgrass Industry. B. V. Lessley, I. E. Strand. Journal of the Northeast Agricultural Economics Council. A2612

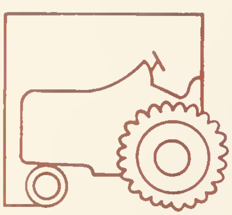
The Economic Feasibility of an Integrated Pulp and Paper Operation. R. F. Esworthy, I. W. Hardie. Journal of the Northeast Agricultural Economics Council. A2627

Use of Markov Process in Predicting Dairy Farm Size Distribution Changes. J. W. Wysong, M. Y. Seyala. Northeast Journal of Agricultural Economics. A2628

Impact on Livestock Producers of U.S. Policies Affecting Feed Supplies. A. M. Prindle. Journal of the Northeast Agricultural Economics Council. A2629

Regular Bulletins

Structure, Costs and Returns for the Maryland Turfgrass Industry, 1976. J. T. Gilbert, B. V. Lessley. 492



Agricultural Engineering

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Development and Construction of Specialized Facilities and Equipment for Use in Agricultural Research. K. E. Felton. R-21

Labor Performance While Wearing a Respirator. A. T. Johnson, C. O. Dotson. R-50

Shear Properties of Frozen Fish Fillet Blocks. F. W. Wheaton. R-53

Mathematical Model of Oyster Population in the Chesapeake Bay. F. W. Wheaton, A. Cabraal. R-57

Water Quality Maintenance in Closed Cycle Fish Culture Systems. F. W. Wheaton, T. B. Lawson. R-58

Water Quality Changes in Oyster Processing. F. W. Wheaton, A. L. Ingling. RD-52

Physiological Responses of Chickens to Varying Environments. L. E. Carr, O. P. Thomas. RM-2

Biophysical Factors Affecting Energy Requirements for Poultry Production. L. E. Carr, E. L. Johnson. RM-3

Curing Primed Maryland Tobacco. B. C. Frey, J. H. Hoyert. RO-55

Utilization of Solar Energy in Broiler Production. J. L. Cain, K. E. Felton, O. P. Thomas, R. B. Brinsfield, L. E. Carr, J. A. Merkel. RAM-49

Spray Irrigation of Domestic Waste Sewage Effluent to Forested Atlantic Coastal Plain Soils. J. H. Axley, J. C. Stevenson, J. E. Ayars. RAKO-51

Assessment of Nonpoint Source Loading From Selected Agricultural Activities. J. E. Ayars, J. H. Axley, R. F. Davis. ROCG-54

Scientific Articles

Foam Fractionation Applied to Aquacultural Systems. F. W. Wheaton, T. B. Lawson, K. M. Lomax. Proceedings of the World Mariculture Society. A2552

A Comparative Model Study of Respiratory Period Prediction on Men Exercising While Wearing Masks. A. T. Johnson, R. H. McCuen. IEEE Transactions on Biomedical Engineering. A2553

High Density Brooding of Broilers. L. E. Carr. Transactions of the American Society of Agricultural Engineers. A2556

Purification of Fish Culture Wastewater by Foam Fractionation. T. B. Lawson, F. W. Wheaton. Transactions of the American Society of Agricultural Engineers. A2558

Time Information for Sampler Hydrograph. A. T. Johnson, J. E. Ayars. Agricultural Engineering. A2603

Correlation of WGBT and Botsball Sensors. A. T. Johnson, G. D. Kirk. American Industrial Hygiene Association Journal. A2608

Design, Evaluation and Effluent Water Quality Analysis of Three Shellstock Washers. S. Chang, F. W. Wheaton. Presented at the 1979 annual meeting of the American Society of Agricultural Engineers. A2614

Modelling To Assess the Effects of Respirator Masks on Working Men. A. T. Johnson, C. O. Dotson. Presented at the summer meeting of the American Society of Agricultural Engineers. A2617

Instrument for Determining Ignition Temperature of Shredded Combustible Materials. A. T. Johnson, A. D. Schlosser, G. D. Kirk, G. L. Long. Transactions of the American Society of Agricultural Engineers. A2618

Energy Aspects of the New DASI Process for Milk Sterilization. A. N. Manor, B. C. Frey, L. E. Stewart. Presented at the summer meeting of the American Society of Agricultural Engineers. A2619

Nonpoint Pollution From Agricultural Watershed. J. E. Ayars, G. McClung, M. Yaramanoglu, D. C. Wolf. Presented at the summer meeting of the American Society of Agricultural Engineers. A2632

Microcomputer-Based Data System for Remote Hydrographic and Sampling Data. R. L. Kort. Presented at the North Atlantic Region meeting of the American Society of Agricultural Engineers. A2637

Getting Started in Microprocessors. A. T. Johnson. Presented at the North Atlantic Region meeting of the American Society of Agricultural Engineers. A2639

A Solar Collection, Storage and Distribution System for Broiler Production. R. B. Brinsfield, K. E. Felton. Presented at the American Society of Agricultural Engineers meeting. A2641

Thermal Characteristics of a Rock Storage Unit for Solar Energy. R. B. Brinsfield, K. E. Felton. Proceedings of the Second Annual Solar Heating and Cooling Systems Conference. A2659

Economics of Heating Maryland Broiler Houses With Solar Energy. J. L. Cain, K. E. Felton, R. B. Brinsfield. Proceedings of the Second Annual Solar Heating and Cooling Systems Conference. A2660

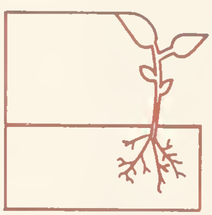
Evaluation of Trickle Irrigation in Maryland. D. S. Ross, R. C. Funt, R. Goulart. American Society of Agricultural Engineers paper 79-2114. A2662

Respiratory Mechanics, Control and Mask Wear. A. T. Johnson. Presented at the 32nd Annual Conference of Engineering in Medicine and Biology. A2668

Miscellaneous Publications

Instrumentation for Surface Runoff Studies. J. E. Ayars, G. T. Fisher, N. T. Martin, G. L. Conner, R. D. Dixon. 942

Procedures Manual for Sediment, Phosphorus and Nitrogen Transport Computations with USDAHL. H. N. Holtan. 943



Agronomy

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Use of Herbicides To Control Weeds in Forages. J. L. Snyder, J. L. Srotman, T. C. Harris, G. W. Burt. B-79

Control of Johnsongrass in Corn and Soybeans. G. W. Burt. B-95

Tobacco Breeding, Testing and Quality Evaluations of Maryland Tobacco. M. K. Aycock, J. H. Hoyert, C. L. Mulchi. B-103

Breeding and Evaluation of Kentucky Bluegrass and Associated Species for Turf. C. A. Darrah, D. J. Wehner. B-109

Varietal Improvement in Wheat and Barley. D. J. Sammons. B-116

Biological Activity and Dissipation of Herbicides Used on Corn, Soybeans and Tobacco. G. W. Burt. B-117

Agronomic Feasibility of Direct-Seeding of Field Tobacco. J. H. Hoyert. B-118

Forage Production and Quality Evaluations. A. M. Decker, R. F. Dudley. B-119

Principles of Dissipation and Movement of Carbamates and Other Herbicides. G. W. Burt. B-121

Physiological Relationships of Tobacco to Environmental, Cultural and Genetic Factors. C. L. Mulchi, J. H. Hoyert, M. K. Aycock.	B-122
Response of Alfalfa to Fertility, Irrigation and Cutting Management. N. A. Clark.	B-123
Reducing the Influence of Air Pollution on Plant Productivity in the Northeast. C. L. Mulchi, M. K. Aycock, W. J. Kenworthy.	B-127
Physiological and Morphological Limitations to Soybean Yield. W. J. Wiebold.	B-128
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Effect of Municipal Sludge on Growth and Elemental Composition of Two Tree Species. J. E. Foss.	BO-2
Evaluation of an Undisturbed Deciduous Ecosystem as a Source of Non-point Pollution. J. E. Ayars, J. F. Kundt.	BO-3
Soil Characterization Studies Relating to Their Genesis, Classification and Utilization. J. E. Foss, D. S. Fannng, J. R. Miller.	O-48
Origin, Transformation and Management of Nitrogen in Soils, Waters and Plants. J. H. Axley, J. Legg, F. Abbruscato.	O-57
Residual Effect of Thirteen Cropping Systems on Corn and Soybean Yields and Soil Aggregation. E. Strickling.	O-81
Soil Testing for Environmental Control. J. H. Axley, P. A. Snow, V. Pavanasasivam.	O-82
Investigation of Heavy Metals in Sewage Sludge-Soil-Plant Systems. D. S. Fanning, J. E. Foss.	O-84
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Soil Properties Affecting Sorption of Heavy Metals From Wastes. D. S. Fanning.	O-86
Identifying and Preventing Sulfur-Related Problems in Soils Created in Coal Mining Operations. D. S. Fanning.	O-87
Forage-Livestock Systems for Land With Soil and Site Limitations. A. M. Decker, R. F. Dudley, H. T. Badger.	O-88
Fertilization of No-Tillage and Conventional Tillage Corn. V. A. Bandel.	O-89

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Response of Maryland Tobacco Cultivars to Various Rates of Nitrogen Fertilization. M. K. Aycock, C. G. McKee. Tobacco Science.	A2562
Immediate Acetylene Reduction by Excised Grass Roots Not Previously Preincubated at Low Oxygen Tensions. P. B. Van Berkim, C. Sloger. Plant Physiology.	A2563
Leaching of EPTC and R-25788 in the Soil. C. A. Buzio, G. W. Burt. Weed Science Journal.	A2574
Strategies for Introgressing Exotic Germplasm in Breeding Programs. W. J. Kenworthy. Paper to be presented at the World Soybean Research Conference.	A2582
A Comparison of N Fertilizers for No-Till Corn. V. A. Bandel, S. Dzienia, G. Stanford. Agronomy Journal.	A2605

Effect of the Hull-less Gene on the Mineral Content of Barley. J. W. Johnson, S. E. Sunderman. Cereal Chemistry. A2609

The Seasonal Relationship Between Polyphenol Level and Helminthosporium Disease Activity on Kentucky Bluegrass. J. K. Mathias, J. R. Hall, C. L. Mulchi. Crop Science. A2621

The Relationship of Nitrogen, Carbohydrate Polyphenol and Cultivar to the Helminthosporium SPP. Susceptibility of Kentucky Bluegrass. J. K. Mathias, J. R. Hall, C. L. Mulchi. Crop Science. A2622

Morphological and Mineralogical Features Related to Sulfide Oxidation Under Natural and Disturbed Uplant Surfaces in Maryland. D. P. Wagner, D. S. Fanning, J. E. Foss, M. S. Patterson, P. A. Snow. Soil Science Society of America Special Publication. A2638

Influence of Time and Rate of Nitrogen Fertilization on Seed Yield and Agronomic Characteristics of Meadowfoam. J. W. Johnson, M. B. Devine, R. Kleiman, G. A. White. Agronomy Journal. A2644

N Behavior Under No-Till and Conventional Corn Culture, III. Utilization of Soil and Fertilizer N in Relation to Amounts of N Applied. J. O. Legg, J. J. Meisinger, G. Stanford, V. A. Bandel. Agronomy Journal. A2645

N Behavior Under No-Till and Conventional Corn Culture. II. Grain and Forage Yields in Relation to Amounts of N Applied and Total N Uptake. G. Stanford, V. A. Bandel. Agronomy Journal. A2646

Registration of Miles Soybeans. W. J. Kenworthy, J. A. Schillinger. Crop Science. A2648

Influence of Flooding on the Availability of Soil Zinc. V. Pavanasasivam, J. H. Axley. Committee on Soil Science Plant Analysis. A2665

Cadmium, Copper, Nickel and Zinc Extractability and Corn Uptake After High Applications to Maryland Soil Materials. R. F. Korcak, D. S. Fanning. Journal of Environmental Quality. A2670

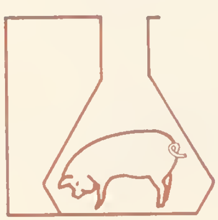
Miscellaneous Publications

Influence of Five Male-Sterile Cytoplasms on the Performance of Maryland Tobacco Cultivars and Hybrids. M. K. Aycock, H. R. Erdogan. 940

Feasibility of Growing and Transplanting Tobacco Seedlings With Intact Root Systems in Pressed Peat-Soil Cubes. J. H. Hoyert. 944

Performance of Winter Barley and Soft Red Winter Wheat in Maryland, 1976-78. D. J. Sammons. 945

Performance of Maryland Tobacco Varieties and Breeding Lines, 1977 and 1978. M. K. Aycock, H. A. Skoog, C. G. McKee, J. H. Hoyert, C. L. Mulchi. 948



Animal Science

Projects

Supplementation of Corn Stover for Wintering Gestating Beef Cows. W. E. Kunkle, J. Buric, E. C. Leffel. C-52

Jugular Vein Plasma Progestin Levels and Effect of Exogenous Progesterone Thereon. J. P. McCall, J. E. Dinger. C-53

Effects of Iron Nutriture on Serum Proteins in Lead Poisoned Rats. J. V. Debarthe, C. Stone. C-55

Nutritional Ramifications of Trichostrongylosis. E. C. Leffel, C. McCullough, M. McCullough. C-56

Radiographic Measurement of Bone Development in Rapidly Developing Foals on Two Levels of Calcium and Phosphorus. J. P. McCall, D. L. Campbell. C-57

Equine In-Vivo Studies of Sperm Longevity. R. E. Bray, J. P. McCall, D. L. Campbell. C-58

Hindgut Function in Nonruminants. J. V. Debarthe, E. P. Young. C-59

Effect of Worming and Anabolic Agents on the Growth of Nursing Beef Calves. W. E. Kunkle, R. C. Hammond. CD-54

Scientific Articles

Effects of Purified Cellulose and Monensic Acid on Cecal Function in Swine. J. D. H. Kane, J. V. Debarthe. Journal of Animal Science. A2557

Effects of Exogenous Ovarian Steroids on Serum Concentrations of LH, FSH and Prolactin on Ovariectomized Sows. D. J. Hoover, H. J. Brinkley, P. L. Rayford, E. P. Young. Journal of Animal Science. A2559

Relationship Between Serum Luteinizing Hormone (LH) Levels and the Ability of Porcine Granulosa Cells to Luteinize and Respond to Exogenous LH in Culture. C. R. Channing, H. J. Brinkley, E. P. Young. Journal of Endocrinology. A2596

Distribution on Spermatoza Recovered From the Oviduct and Uterotubal Junction of the Mare at 48 or 72 Hours Post-Insemination. J. P. McCall, R. E. Bray, D. L. Campbell. Journal of Animal Science. A2623

Botany

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Native Plants of Maryland. J. L. Reveal, S. Hill, R. Brown, M. Brown. F-12

Comparative Vegetative Anatomy of Flowering Plants. W. L. Stern. F-21

Biosystematic Studies of North American Vascular Plants. J. L. Reveal. F-24

Treatment of Soil and Underground Parts of Plants for the Control of Plant Diseases. O. D. Morgan, J. G. Kantzes. J-93

Viral and Viral-like Diseases of Plants in Maryland. M. K. Corbett. J-98

Virus and Mycoplasma Diseases of Deciduous Tree Fruits and Grapevines. M. K. Corbett, L. O. Weaver. J-100

Production of Multiple Disease Resistant Type 32 Maryland Tobacco With Improved Quality and Yield. O. D. Morgan, M. K. Aycock. J-103

Selection and Nature of Induced Mutations in Higher Plant Cells. P. J. Bottino. J-107

Mode of Action, Metabolism and Field Performance of Fungicides. H. D. Sisler, J. G. Kantzes . J-109

The Impact of Nematode Population on Crop Yield. L. R. Krusberg, D. J. Chitwood, D. E. Babineau, E. M. Dutky, S. Sardinelli. J-110

Mycotoxins of Corn and Other Feed Grains. G. A. Bean. J-111

Physiology of Chesapeake Bay Phytoplankton. E. P. Karlander. K-13

Lipid Composition and Biosynthesis in Soybeans. G. W. Patterson. K-15

Morphological, Ultrastructural and Biochemical Characterization of Nanoplankton From Chesapeake Bay. G. W. Patterson, S. D. Van Valkenburg. K-16

Control of Nitrate Partitioning Among Reduction, Storage and Translocation in Crop Plants. N. M. Barnett. K-17

Plant Stress Caused by Pesticide Use. W. L. Klarman. K-18

Scientific Articles

Effects of Miconazole and Dodecylimidazole on Sterol Biosynthesis in Ustilago maydis. M. J. Henry, H. D. Sisler. Antimicrobial Agents Chemotherapy. A2518

Who Was Redding of Oxytheca reddingianum? J. L. Reveal, A. H. Reveal. Madrono. A2542

Biogeography of the Intermountain Region, A Speculative Appraisal. J. L. Reveal. Mentzelia. A2560

Site of Inhibition by Tricyclazole in the Melanin Biosynthetic Pathway of Verticillium dahliae. M. C. Tokousbalides, H. D. Sisler. Pesticide Biochemistry and Physiology. A2561

Mode of Action of the Azasteroid Antibiotic 15-aza-24-methylene-D-homocholesta-8, 14-diene-3βol in Ustilago maydis. C. P. Woloshuk, H. D. Sisler, S. R. Dutky. Antimicrobial Agents Chemotherapy. A2575

The Effect of Cultural Conditions on the Sterol and Fatty Acid Composition of Six Green Algae. D. C. Wright, L. R. Berg, G. W. Patterson. Plant Physiology. A2587

Biodegradation of Agricultural Fungicides. H. D. Sisler. Presented at the USA-India Conference on Biodegradable Fungicides. A2599

A Revision of the Genus Oxytheca Nutt. (Polygonaceae). B. J. Ertter. Brittonia. A2602

Thymine Dimer and Glyceollin Accumulation in UV-Irradiated Soybean Suspension Cultures. J. J. Reilly, W. L. Klarman. Environmental and Experimental Botany. A2610

Sterol Composition of Nystatin and Amphotericin B. Resistant Tobacco Calluses. P. L. Chiu, P. J. Bottino, G. W. Patterson. Lipids. A2620

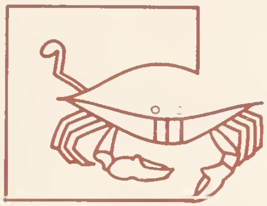
Organic Acids and Ionic Balance in Xylem Exudate of Wheat During Nitrate or Sulfate Absorption. E. W. Triplett, N. M. Barnett, D. G. Blevins. Plant Physiology. A2624

The Effect of Steric and Nuclear Changes of Steroids and Triterpenoids on Sexual Reproduction in Phytopthera cactorum. W. D. Nes, G. W. Patterson, G. A. Bean. Plant Physiology. A2625

Effects of Glyphosate on a Common Unicellular Alga. S. L. Hamann-Christy, E. P. Karlander, J. V. Parochetti. Weed Science. A2633

Cloning Vegetable Crops Via In Vitro Techniques. P. J. Bottino. Principles and Practices of Cloning Agricultural Plants Via In Vitro Techniques. A2658

Growth Rates of Pseudopedinella pyriforme (Chrysophyceae) in Response to 75 Combinations of Light, Temperature and Salinity. C. Ostroff, E. P. Karlander, S. D. Van Valkenburg. Journal of Psychology. A2666



Center for Environmental and Estuarine Studies

Projects

Ecological Adaptation and Characteristics of 100 Geographic Populations of Pinus strobus. J. B. Genys. Z-1

Tree Damage and Forest Management Implications of the Locust Borer Megacyllene robinia in Maryland. D. Harmon. Z-2

College of Human Ecology

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Consumer, Market and Laboratory Studies of Flame-Resistant Textile Items. B. F. Smith, S. M. Spivak, R. Dardis. Y-10

Quality Housing Environment for Low-Income Families. G. S. Fish. Y-11

An Analysis of Consumer Income and Expenditures. E. A. Hacklander, R. Dardis, F. W. Derrick. Y-12

Development of Nutrition Education Curricula for Use in the Teams-Games-Tournaments Teaching Program. L. A. Wodarski. Y-13

Scientific Articles

Risk Evaluation in Adult Sleepwear. J. A. Stremel, R. Dardis. Proceedings of 12th Annual Meeting, Information Council on Fabric Flammability. A2551

The Family Life Cycle: An Alternative Methodology. F. W. Derrick, A. K. Lehfeld. Presented at the annual meeting of the Eastern Economics Association. A2598

Ethical Issues in Cost-Benefit Analysis. R. Dardis. Proceedings, 25th Annual Conference of the American Council on Consumer Interests. A2601

Cross Section Studies of the Demand for Recreation in the United States. R. Dardis, F. W. Derrick, K. E. Wolfe. Journal of Leisure Research. A2667

Miscellaneous Publications

Teaching Nutrition by Teams-Games-Tournaments: An Application of Behavioral Analysis. L. A. Wodarski, C. L. Adelson, M. T. Todd, J. S. Wodarski. 941

Changing Patterns of Consumption Expenditures. A. K. Lehfeld, R. Dardis. 946

Dairy Science

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Scientific Articles

Biosynthesis of Mammary Glycoproteins. I. Formation of Lipid-Linked Derivatives of N-acetylglucosamine and Mannose. D. F. Lewis, I. K. Vijay. Biochimica Biophysica Acta. A2589

Biosynthesis of Mammary Glycoproteins. II. Biosynthesis and Metabolism of Lipid-Linked Derivatives of Glucose and a Glucosidase Potentially Involved in Glycoprotein Processing. D. F. Lewis, I. K. Vijay. Biochimica Biophysica Acta. A2590

Effects of Essential Fatty Acid Deficiency on Ganglioside Content of the Developing Mouse Brain. M. C. McKenna, A. T. Campagnoni. Brain Research. A2607

The Microbiology of UHT Milk. D. C. Westhoff. Journal of Dairy Science. A2636

Effect of Primary, Secondary and Tertiary Amines in Vitro Cellulose Digestion and Volatile Fatty Acid Production by Ruminal Microorganisms. K. A. Baldwin, J. Bitman, M. L. Thompson, W. E. Robbins. Journal of Dairy Science. A2671

Director's Office

Projects

A Computerized Managerial Accounting System for Agricultural Experiment Stations. F. E. Bender. V-5

Scientific Articles

Sterile Acceptable Milk (SAM), Phase One, Final Report, Volumes I-III. Department of Energy Final Report. A2647

Entomology

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Handbook of the Armored Scale Insects of Economic Importance in Maryland. J. A. Davidson. H-110

Habitat Relationships and Roost Management of Flocking Blackbirds and Starlings. D. H. Messersmith. H-114

Biology of Stored Product Pests and Their Susceptibility to Microsporidian Infections. E. Armstrong. H-115

Honey Bee Pollination: Effects of Management and Pests on Honey Bee Populations. D. M. Caron. H-116

Insects on Turf and Economically Important Native Grasses in Maryland: An Ecosystem Approach. R. F. Denno. H-117

The Biology and Control of Insect and Mite Pests of Ornamental Plants in Maryland. J. A. Davidson. H-118

Studies of Insect Hemocytes. J. C. Jones, M. Clark. H-119

The Metabolism and Fate of Pesticides and Their Residues in or on Agricultural Commodities. R. E. Menzer, J. O. Nelson. H-120

Agricultural Pesticide Impact Assessment. A. L. Steinhauer. H-121

Decisionmaking and Biological Monitoring Methodology for Field Crop Pest Management. G. P. Dively, F. P. Harrison. H-122

Exploration for and Introduction and Colonization of Parasites of the Mexican Bean Beetle. A. L. Steinhauer, A. R. Giron. H-123

Colonization, Biology and Behavior of the Nantucket Pine Tip Moth and Its Two Major Parasites. A. L. Steinhauer, A. R. Giron, W. L. Murphy. H-124

Control of Orchard, Small Fruit and Vineyard Pests. E. R. Krestensen. H-125

Pest Management Strategies for Tobacco Budworm and Tobacco Hornworm in Maryland. F. P. Harrison. H-126

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Selection of More Virulent Baculoviruses by Chemical Mutagenesis. C. F. Reichelderfer, J. T. McClintock. H-129

The Abundance, Distribution and Ecology of Face Fly in Maryland. A. L. Steinhauer, O. Young. H-130

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Ecotope Differentiation in a Guild of Sap-Feeding Insects on the Salt Marsh Grass, Spartina patens. R. F. Denno. Ecology. A2555

Behavioral Characters as Indicators of Yellowjacket Phylogeny (Hymenoptera: Vespidae). A. Greene. Annals of the Entomological Society of America. A2564

Coevolution Between Systematics and Ecology: Dependency, Trends and Predictions. R. F. Denno. Bulletin of Entomological Society of America. A2580

Migration in Heterogeneous Environments: Differences in Habitat Selection Between the Wing-Forms of the Dimorphic Planthopper, Prokelisia marginata (Homoptera: Delphacidae). R. F. Denno, M. J. Raupp, D. W. Tallamy, C. F. Reichelderfer. Ecology. A2581

Some Trichoptera and Hymenoptera From Iceland and Greenland. D. H. Messersmith. Entomologiae Scandinaviae. A2585

A New Species of Midge of the Genus Forcipomia Meigen (Diptera: Ceratopogonidae) From North America. D. H. Messersmith. Proceedings of the Entomological Society of Washington. A2586

New Research on Bee Pollination of Crops—A Report of the IVth International Symposium on Pollination. D. M. Caron. Bee World. A2591

Responses of Sap-Feeding Insects (Homoptera-Hemiptera) to Simplification of Host Plant Structure. D. W. Tallamy, R. F. Denno. Environmental Entomology. A2606

Comparison of Parasitism and Infestation of Nantucket Pine Tip Moth in Differing Aged Stands of Loblolly Pine. J. Lashomb, A. L. Steinhauer, G. P. Dively. Environmental Entomology. A2613

Loss Assessments and Decisionmaking for the Tobacco Budworm on Maryland Tobacco. D. M. Kolodny-Hirsch, F. P. Harrison. Journal of Economic Entomology. A2634

Hematocrit Method for Determining Total Hemocyte Counts of Larvae of the Tobacco Budworm, Heliothis virescens (Lepidoptera: Noctuidae). M. E. Clark, J. C. Jones. Annals of the Entomological Society of America. A2655

No-Till Culture of Sweet Corn in Maryland With Reference to Insect Pests. F. P. Harrison, R. A. Bean, O. J. Qawiyy. Journal of Economic Entomology. A2656

Chemical Sprays for Control of Insects Attacking Sweet Corn in Maryland. F. P. Harrison. Journal of Economic Entomology. A2657

The North American Predaceous Midges of the Genus Palpomyia. W. L. Grogan, W W. Wirth. Entomological Society of Washington Memoirs. A2664

A New Tribe, Geuns and Species of Cossyphodine From Peru (Coleoptera: Tenebrionidae). W. E. Steiner. Proceedings of the Entomological Society of Washington. A2672

Special Miscellaneous Publications

Proceedings of the IVth International Symposium on Pollination. D. M. Caron, editor. 1

Horticulture

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Perceptions of Scenic Resources in the Rural Landscape. D. G. Pitt. I-60

Effect of Environmental Factors and Cultural Practices on the Growth and Flowering of Plant Crops. J. B. Shanks, C. B. Link. I-74-A

Cold Protection Systems for Overwintering Plants and for Winter Protection. C. B. Link, F. R. Gouin. I-79-A

Cultural Management Practices Related to the Production of Woody Plants. C. B. Link, F. R. Gouin. I-79-B

Response of Nursery Grown Azaleas to Aluminized Plastic, Black Plastic and Organic Mulches. H. G. Mityga. I-79-C

Chemical Promotion or Modification of Ornamental Plants for Efficient Production in the Greenhouse. J. B. Shanks, J. E. Rissler. IJ-75-B

Effects of Varied Temperature Regimes on Growth and Flowering of Ornamentals in the Greenhouse. J. B. Shanks, D. S. Ross. IR-75-A

Adaptation of Fruit Varieties and New Seedlings to Maryland. A. H. Thompson, J. B. Shanks, H. J. Swartz. L-73

Environmental Factors and Cultural Practices in Relation to the Growth and Fruiting Responses of Fruits. A. H. Thompson, B. L. Rogers, H. J. Swartz. L-74

Chemical Thinning of Apples and Peaches. A. H. Thompson, B. L. Rogers. L-74-B

Investigations in High-Density Plantings of Apple, Peach and Pear. A. H. Thompson, B. L. Rogers. L-74-D

Control of Postharvest Decay of Fruits and Vegetables. T. Solomas, J. A. Merkel. L-79-G

Use of CA Storage and Chemicals To Prolong Marketing Life of Apples, Potato Tubers and Cut Flowers. T. Solomos, R. C. Wiley. L-79-J

Time-Temperature Relations of Enzymatic Conversion of Polysaccharides to Sugars in Sweet Potato Roots. J. C. Bouwkamp. L-80-A

Composed Sewage Sludge in Forest Nursery Seedling Production. F. R. Gouin, C. B. Link, J. F. Kundt, P. R. Beckjord.	L-101
Pine Tree Response to Composted Sewage Sludge. J. F. Kundt, F. D. Schales, I. W. Hardie, P. R. Beckjord.	L-105
Hybrid Pine Development (Pitch X Loblolly Pine). J. F. Kundt, P. R. Beckjord.	L-106
Comparisons of Mycorrhizal and Nonmycorrhizal Forest Tree Seedlings. P. R. Beckjord, E. Haskaylo, J. F. Kundt.	L-107
Influence of Summer Shearing and Nitrogen on Yield and Quality of Peaches in High Density. A. H. Thompson, B. L. Rogers, E. R. Krestensen, T. Solomos.	LH-75-A
Quality Maintenance and Control in the Marketing and Storage of Vegetables. A. Kramer.	Q-58-W
Quality Maintenance and Control in the Marketing and Storage of Vegetables. T. Solomos, J. C. Bouwkamp.	Q-58-X
Functional Properties of Proteins. A. Kramer, J. C. Bouwkamp, R. C. Wiley.	Q-60-A
Efficacy and Selectivity of Herbicides for Weed Control in Truck Crops. C. E. Beste, F. D. Schales.	Q-77-B
Weed-Crop Competition. C. E. Beste, F. D. Schales.	Q-77-E
Breeding and Selection of Fresh Market and Processing Tomatoes. J. C. Bouwkamp.	Q-81-A
Genetic Improvement of Muskmelon and Other Curcurbit Crops. T. J. Ng.	Q-81-C
Breeding and Selection of Horticultural Crop Plants. J. C. Bouwkamp, C. B. Link, J. B. Shanks, T. J. Ng.	Q-81-F
Discovery and Preservation of Valuable Plant Germ Plasm. J. C. Bouwkamp, T. J. Ng.	Q-81-H
Trickle Irrigation in Humid Regions. C. W. Reynolds, H. J. Swartz.	Q-82
The Dynamics and Energetics of the Soil-Plant-Atmosphere Continuum (SPAC). C. W. Reynolds.	Q-83
Development of New Products and Improved Processing Methods. R. C. Wiley, A. Kramer.	Q-84-D
Balancing Costs vs Sensory and Nutritional Quality Gains in Refrigerated Storage of Foods. A. Kramer, F. E. Bender.	Q-84-E
Genetics and Physiology of Sweet Corn Quality, Pest Resistance and Yield. R. C. Wiley, T. J. Ng, C. A. McClurg.	Q-85-A
Regional Adaptation and Market and Processing Quality of Vegetable Species and Cultivars. F. D. Schales, J. C. Bouwkamp, C. W. Reynolds, T. J. Ng, C. A. McClurg, J. G. Kantzes.	QJ-75
Breeding of Stress Tolerant, Root Rot Resistant Snap Beans. T. J. Ng, J. G. Kantzes, F. D. Schales.	QJ-81-B
Crop Management Studies With Vegetable Crops. C. W. Reynolds, F. D. Schales, C. E. Beste, T. J. Ng, J. C. Bouwkamp.	Q-77-A

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Effect of Processing and Storage on Sensory and Nutritional Quality of Raw, Frozen and Canned Green Beans and Broccoli. W. N. Lee, Y. Onishi, A. Kramer. ASHRAE Journal.	A2554

Defining Congestion Among Recreation Boaters. D. G. Pitt, C. W. Colton, J. W. Morgan, T. H. Chaney. Proceedings of Recreation Planning 79. A2567

Temperature Measurements and Growth Response of Container Grown Ornamentals Overwintered Outside Unprotected, in Nursery Shelters and Under Microfoam Thermo-blankets. F. R. Gouin, C. B. Link. Journal of the American Society for Horticultural Science. A2569

Behaviors and Perceptions of Recreational Boaters. C. W. Colton, D. G. Pitt, J. W. Morgan, T. H. Chaney. Proceedings of Recreation Planning 79. A2568

Yield and Harvest Season of Three Red Raspberry Cvs in the Fall-Fruit-Only System of Management. H. D. Stiles. HortScience. A2570

Amino Acid, Fatty Acid, Cholesterol and Other Sterols Analyses of Different Pizza Formulations. B. Kamel, A. Kramer, A. J. Sheppard, D. R. Newkirk. Journal of Food Quality. A2571

Response of Muskmelons on Mulched Beds to Varying Plant Density. T. J. Ng, F. D. Schales. HortScience. A2572

Quality Criteria for Chilled Foods. A. Kramer. Presented at the XV International Congress of Refrigeration, to be published in proceedings. A2576

Cost/Benefit Relationships From Low Temperature Storage. A. Kramer, F. E. Bender. Presented at the XV International Congress of Refrigeration, A2577

SEM in the Study of Comparative Testa Morphology. L. R. LaSota, C. B. Link, C. R. Gunn. Scanning Electron Microscopy. A2588

The Q-Sort Method: Use in Landscape Assessment and Landscape Planning Research. D. G. Pitt, E. H. Zube. Proceedings of Our National Landscape Conference. A2592

Effect of Consuming Food Supplemented With Single Cell Protein on Urine and Serum Uric Acid Levels. B. S. Kamel, A. Kramer. Journal of Food Quality. A2593

Energy Savings and Quality Deterioration in Frozen Meat Stored at Different Daytime and Nighttime Temperatures. B. H. Ashby, M. Moleeratanond, H. R. Cross, A. Kramer, W. A. Bailey. Presented at the XV International Congress of Refrigeration, to be published in proceedings. A2594

Propagation of Woody Plants Under a Thermo-Blanket. C. T. Mewshaw, F. R. Gouin, C. B. Link. American Nurseryman. A2595

Qualities We Aim To Maintain. A Kramer. Proceedings of the 7th Long Ashton Symposium. A2597

Effect of Phosphorus, Nitrogen and Daminozide on Growth and First Fruiting of Dwarf Apple Trees. J. M. Williams, A. H. Thompson. HortScience. A2600

A Betacyanine Decolorizing Enzyme Found in Red Beet Tissue. D. Lashley, R. C. Wiley. Journal of Food Science. A2604

Effects of Triacontanol on Sweet Potatoes (Ipomoca batatas (Lam) L.). J. C. Bouwkamp, R. N. McArdle. HortScience. A2611

Strategies for Improving Protein Production in Sweet Potatoes. J. C. Bouwkamp. Proceedings of the 5th International Symposium on Tropical Root Crops. A2616

Introduction to the Symposium. F. R. Gouin. HortScience. A2626

Evaluation of Muskmelon Cultivar Performances by Joint Regression Analysis. T. J. Ng, C. A. McClurg, F. F. Angell, J. I. Anderson. Journal of the American Society for Horticultural Science. A2630

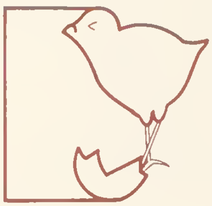
Purification and Isolation of Table Beet Root Pigments. T. Solomos, T. W. Warman, J. J. Saladini, R. C. Wyss, H. H. Topalian. Journal of Food Science. A2635

The Effect of Plant Growth Regulators and Temperatures on the Retention of Cyathia in Poinsettia (Euphorbia pulcherrima Willd.). J. B. Shanks, A. Purohit. Proceedings of the Sixth Annual Meeting of the Plant Growth Regulator Working Group. A2643

Influence of Ancymidol on Four Species of Tropical Foliage Plants Under Different Artificial Light Intensities. T. M. Blessington, C. B. Link. Journal of the American Society for Horticultural Science. A2650

Recent Trends in Food Processing Research. R. C. Wiley. Journal of Food Technology in Yugoslavia. A2652

Composted, Digested Sewage Sludge as a Medium for Growing Flowering Annuals. R. D. Wotton, F. R. Gouin, F. C. Stark. Journal of the American Society for Horticultural Science. A2669



Poultry Science

Projects

Applied Broiler Nutrition Studies. O. P. Thomas, E. L. Johnson. M-66

Studies of Methods in Poultry Processing Plants and Hatcheries To Reduce Pollution. W. C. Merka, L. E. Carr, W. J. Kuenzel. M-108

Morphological and Physiological Studies of an Epileptiform Seizure Pattern in Chickens, Gallus domesticus. W. J. Kuenzel, N. M. Schaefer. M-110

Cleaning and Preservation of Shell Eggs Without Refrigeration. J. L. Heath. M-111

Metabolic Rates, Vital Signs, Body Temperature and the Control of Food Intake in Growing Chicks. W. J. Kuenzel. M-112

Poultry Product Quality. J. L. Heath. M-113

Endocrine Involvement in the Reproduction Capability of the Maturing and Aging Bird. M. A. Ottinger. M-114

Mycotoxicoses and Endocrine Function in Poultry. J. A. Doerr, M. A. Ottinger. M-115

Nutritional Improvement in the Northeast Region. M. Rubin, O. P. Thomas. M-212

Interrelationship of Selenium and Cystine With Mercury. J. H. Soares, L. J. Kling. M-213

Amino Acid Requirements of Broilers and Laying Hens. O. P. Thomas, E. H. Bossard, J. H. Soares. M-216

Eggshell Quality in Avian Species. J. H. Soares, M. A. Ottinger. M-217

Mycotoxins in Poultry Production. J. A. Doerr. M-218

Scientific Articles

Spenomegaly in Japanese Quail Fed Low Vitamin E Diets. J. J. Cunningham, J. H. Soares. Nutrition Reports International. A2530

Gaseous Metabolism of Leghorns and Broilers During Early Growth: Resting Metabolic Rate. D. M. Denbow, W. J. Kuenzel. Poultry Science. A2536

Ultrasonic Vibration as an Aid in the Acetic Acid Method of Cleaning Eggs. J. L. Heath, S. L. Owens, J. W. Goble. Poultry Science. A2573

Erythrocyte Ghost Tocopherol Levels in Chicks Deficient or Sufficient in Vitamin E. J. J Cunningham, J. H. Soares. Journal of Nutrition. A2615

Feed Requirements for Egg Production. T. C. Byerly, J. W. Kessler, R. M. Gous, O. P. Thomas. Poultry Science. A2631

Vitamin E Deficiency in the Japanese Quail. L. J. Kling, J. H. Soares. Poultry Science. A2642

Veterinary Science

Projects

Virology of the Bovine Respiratory Disease Complex. S. B. Mohanty. D-63

Virology of the Equine Respiratory Disease Complex. S. K. Dutta. D-70

Adequacy of Thermoregulatory Response to Cold Stress as a Factor in Decreased Disease Resistance. T. F. Albert, A. L. Ingling. D-71

Veterinary Support for University of Maryland Animals. D. L. Campbell, J. P. Davidson, R. C. Hammond. D-73

Detection and Control of Three Economically Important Avian Diseases. W. W. Marquardt, R. B. Johnson. D-74

Infectious Laryngotracheitis (ILT), Avian Influenza (AI) and Infectious Bursal Disease. W. W. Marquardt, R. B. Johnson. D-75

Resistance of Cattle to Parainfluenza-3 and Respiratory Syncytial Viruses. S. B. Mohanty. D-77

Correlation of Bovine Endometrial Scarring Using Biopsy, Culture and Necropsy Studies. J. E. Manspeaker. D-78

Scientific Articles

Effect of 2-Deoxy D-Glucose and Glucosamine on Bovine Respiratory Syncytial Virus. R. N. Tripathy, S. B. Mohanty. American Journal of Veterinary Medicine. A2565

Application of Enzyme-Linked Immunosorbent Assay (ELISA) for Detecting Antibodies to Infectious Bursal Disease Virus. W. W. Marquardt, R. B. Johnson, W. F. Odenwald, B. A. Schlotthober. Journal of the American Veterinary Medical Association. A2579

Bacterial Flora of the Uterus of the Dairy Cow at Four and Twenty-One Days Postpartum. D. L. Campbell, J. W. Thomas. Presented at the meeting of the Society of Theriogenology. A2649

Chemotherapeutic Effect of 2-Deoxy-D-Glucose in Infectious Bovine Rhinotracheitis Viral Infection in Calves. S. B. Mohanty, D. R. Rockemann, R. N. Tripathy. Journal of the American Veterinary Medical Association. A2651

The Enzyme-Linked Immunosorbent Assay (ELISA) for Detecting Antibodies to Infectious Bursal Disease Virus and for the Study of Other Viral Diseases. W. W. Marquardt, R. B. Johnson, W. F. Odenwald, B. A. Schlotthober. Presented at the Pennsylvania Veterinary Poultry Meeting. A2661

The Immunization Process. W. W. Marquardt. Presented at the Maryland Poultry Servicemen's Conference. A2663

Financial Statement 1978-79

Sources of Income (State FY 79)

Hatch Formula Funds	$1,112,487
Hatch Regional Funds	391,171
McIntire-Stennis Funds	143,289
Rural Development Funds	17,723
Animal Health Funds	42,351
Total Federal Funds	1,664,670
State Appropriations Per State FY 79 Budgets	3,720,598
Total Funds	$5,427,619

Expenditures by Major Research Areas

	Percentage	Amount
Natural Resources and Environmental Quality	14	$ 759,867
Forestry Production	3	162,828
Field and Horticultural Crops	41	2,225,324
Animals and Poultry	24	1,302,628
People, Communities and Institutions:		
Nutrition, Food Safety, Clothing and Housing	10	542,762
Marketing, Trade, Price and Income Policy	5	271,381
General Resource Technology	3	162,829
Total	100	$5,427,619

Tobacco Research Farm
One of 10 Experiment Station research farms.

Maryland's Research Farms

With a blend of basic and applied research, Maryland Agricultural Experiment Station scientists provide a continuing flow of new knowledge essential to the solution of the practical problems facing farmers today. The Experiment Station carries out its research programs at field stations located across the state, reflecting the regional differences of Maryland farming.

Visitors are always welcome at the Experiment Station field stations. Please contact the station for specific information on location and hours of operation.

1 **University of Maryland College Park**
MAES Headquarters (301) 454-3707
College of Agriculture (301) 454-3702
Research work in all phases of agriculture and related fields.

2 **Plant Research Farm** (Montgomery county)
Research on turfgrass, insects, truck crops and small fruit. 320 acres. (301) 572-7247—agronomy; (301) 572-5339—horticulture.

3 **Agronomy-Dairy Forage Farm** (Howard county)
Studies of dairy nutrition and management and pollution abatement practices. 926 acres. (301) 286-3211.

4 **Horse Research Center** (Howard county)
Research on physiology, nutrition and management of horses. 160 acres. (301) 742-1260.

5 **Beef Research Center** (Carroll county)
Research concerning livestock production and management. 720 acres. (301) 795-1310.

6 **Tobacco Research Farm** (Prince George's county)
Research relating to tobacco breeding, production, harvesting and curing. 206 acres. (301) 627-3273.

7 **Wye Research Center** (Queen Anne's county)
Work on plant breeding, weed and disease control, and production systems for corn, soybeans, vegetables and ornamentals. 125 acres. Additional research in cooperation with Wye Institute. 220 acres. Work with Wye Angus herd. Approximately 400 acres on Wye Plantation. (301) 827-7388.

8 **Salisbury Research Substation** (Wicomico county)
Experimental studies dealing with poultry and breeding, insect, pest and disease control, production systems and management and processing of vegetable crops. 89 acres. (301) 742-8788.

9 **Poplar Hill Research Farm** (Wicomico county)
Studies of disease control, breeding, pest control and production systems for corn, soybeans and vegetable crops. 100 acres. (301) 742-9644.

10 **Fruit Research Center** (Washington county)
Research on fruit production, disease control and fruit insects. 28 acres (leased). (301) 578-6718.

11 **Sharpsburg Research and Education Center** (Washington county)
Research on fruits, vegetables, ornamentals, field crops, soils and disease and insect control. 546 acres. (301) 578-6718.

12 **University of Maryland Eastern Shore**
MAES 1890 Agricultural Research Program
Research work in human nutrition, pest control and cultural practices for soybeans and corn, small farm development, child development. (301) 651-1598.